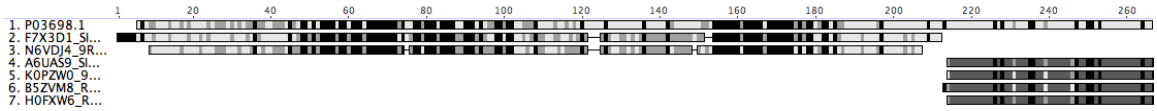
Search for Beta Homologue Recombinases

λ-red recombination protein beta is responsible for oligonucleotide annealing during MAGE, but it is specific to *E. coli.* Using search tools that compare nucleotide sequences to organisms and viruses in NCBI and UniProtKB databases, nine λ beta and SPP1 35 homologues were identified that exist in Rhizobium species. As can be observed in the table below, the closest homologue to λ beta is a bacteriophage recombination protein (F7X3D1_SINMM) found in *S. meliloti SM11*, with 51.8% identical base pairs between base pairs 41 and 182 on the UniProt sequence. Many of the homologues are phage beta proteins, and all of the homologues function in recombination. In the figure below, two of the beta homologues have homology at the 5' end and four beta homologues have homology at the 3' end.

Amino acid sequence identities and similarities of homologies to λ-red beta and SPP1 35 found using HMMER.

Search sequence	***Homologue (UniprotKB Number)***	***E-value***	***Query Region***	***% Base Pair Identity (count)***	***% Base Pair Similarity (count)***
λ-red beta protein (P03698)	F7X3D1	1.50E-36	41-182	51.8 (71)	74.5 (102)
	N6VDJ4	2.30E-42	20-182	51.3 (81)	70.3 (111)
	A6UAS9	2.80E-05	30-85	26.8 (15)	64.3 (36)
			140-222	22.9 (19)	68.7 (57)
	K0PZW0	2.20E-05	28-83	25.0 (14)	66.1 (37)
			131-187	26.3 (15)	71.9 (41)
	B5ZVM8	0.00041	32-82	27.5 (14)	64.7 (33)

			140-189	28.0 (14)	66.0 (33)
	H0FXW6	9.60E-13	36-216	23.8 (43)	68.0 (123)
SPP1 35 protein (Q38143)	L0NDY8	4.90E-12	20-276	30.8 (74)	52.1 (125)
	J0GZ13	1.50E-09	31-239	29.8 (62)	50.5 (105)



Alignment λ-red beta (P03698) and beta homologues (F7X3D1, N6VDJ4, A6UAS9, K0PZW0, B5ZVM8, H0FXW6).